AIDS TO MARINE NAVIGATION OF THE UNITED STATES

CG-193

TREASURY DEPARTMENT
UNITED STATES COAST GUARD

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CONTENTS

FOREWORD

The purpose of this publication is to acquaint those who are interested in the study of the science of navigation with the basic principles underlying the marking of coasts and waterways of the United States and its possessions with lighthouses, lightships, fog signals, radiobeacons, loran, and buoys. It explains briefly the significance of the various colors of lighthouses and buoys, of the wide variety of light and fog signal characteristics, and of the system of electronic aids to navigation. It states in simple terms the manner in which the information provided by these aids is applied in actual navigation.

The text treats primarily with the manner in which the physical characteristics of the various aids to navigation serve the mariner. Engineering problems connected with the construction and maintenance of the aids to navigation are not discussed, nor is the publication intended to replace the Light Lists, Coast Pilots, and other Government publications which should be at hand during actual navigation.

GENERAL

DEFINITION

The expression "Aids to Navigation" as used herein, includes lighthouses, lightships, radiobeacons, loran, fog signals, buoys, minor lights, and daybeacons.

THE PURPOSE OF AIDS TO NAVIGATION

Aids to navigation are placed at various points along the Nation's coasts and navigable waterways as markers and guides to enable mariners to determine at all times their exact position with relation to the land and to hidden dangers. Within the bounds of actual necessity and reasonable cost, each and every aid is designed to be seen or heard over the greatest practicable area.

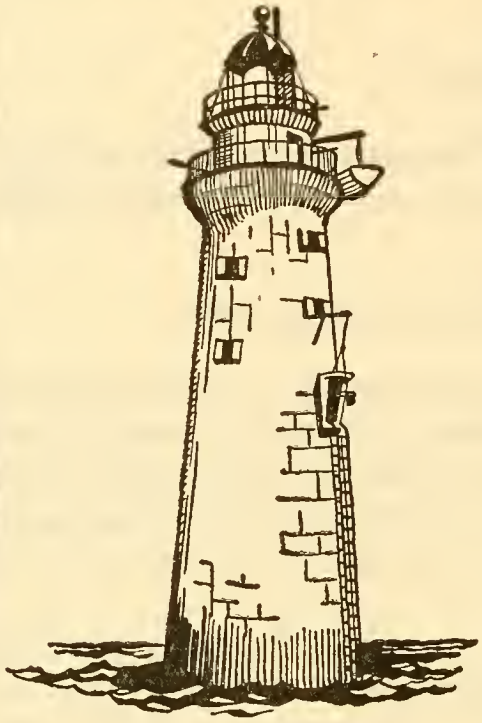
Aids to navigation assist mariners in making landfalls when approaching from overseas, mark isolated dangers, make it possible for vessels to follow the natural and improved channels, and provide a continuous chain of charted marks for coast piloting.

As all aids to navigation serve the same general purpose, such structural differences as those between an unlighted buoy and a lightship, or a lighthouse and a radiobeacon, are solely for the purpose of meeting the conditions and requirements of the particular location at which the aid is to be established.

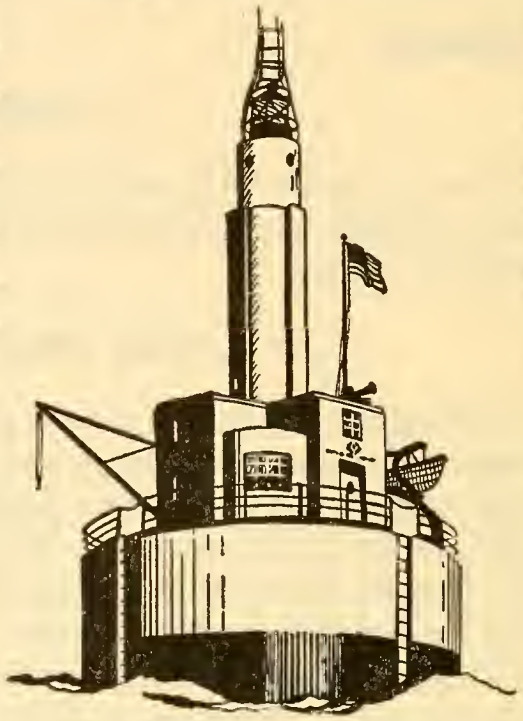
LIGHTHOUSES

Lighthouses are found upon all coasts of the United States, upon the Great Lakes, and along some of the interior waterways of the country. Such structures are so well known as to require little description. Lighthouses are placed where they will be of most use, on prominent headlands, at entrances, on isolated dangers, or at other points where it is necessary that mariners be warned or guided. Their principal purpose is to support a light at a considerable height above the water. The same structure may also house a fog signal and radiobeacon equipment, and also contain quarters for the keepers. However, in the majority of instances, the fog signal, the radiobeacon equipment, and the operating personnel are housed in separate buildings grouped around the tower. Such a group of buildings constitutes a light station.

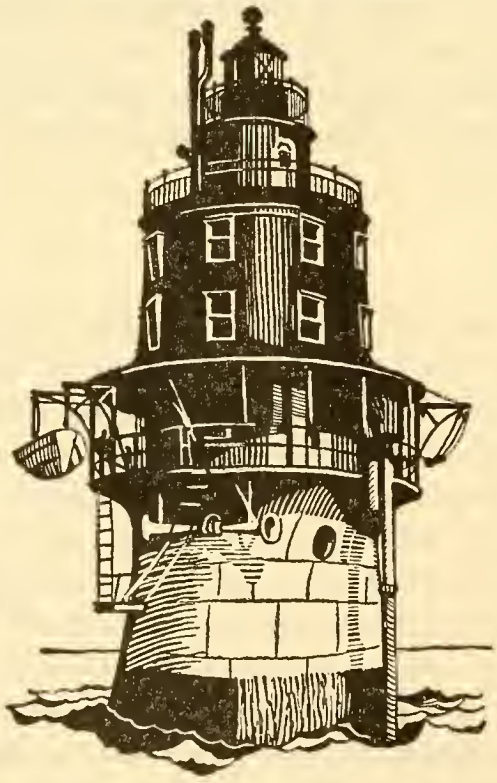
TYPICAL LIGHT STRUCTURES



MASONRY STRUCTURE



CYLINDRICAL TOWER SQUARE HOUSE ON CYLINDRICAL BASE



CYLINDRICAL CAISSON STRUCTURE

SKELETON IRON STRUCTURE

The location of a lighthouse, whether in the water or on shore, the importance of the light, the kind of soil upon which it is to be built, and the prevalence of violent storms, have a direct bearing upon the type of structure erected and on the materials of which it will be built. Engineering problems will not be entered into here, but it is important to note that the materials used and types of construction differentiate one lighthouse from another and hence aid in identification.

Lighthouses vary markedly in their outward appearance because of the points already mentioned and also because of the great difference in the distances to which their lights should be seen. Where the need for a powerful light is great and the importance and density of traffic warrants, a tall tower with a light of high candlepower is erected. Conversely, at points intermediate to the major lights, where the traffic is light, and where long range is not so necessary, a less expensive structure of more modest dimensions suffices.

The terms, secondary lights, minor lights, and automatic lights indicate in a general way a wide variety of lights, each class shading imperceptibly into the next. These lights may be displayed from towers resembling the important seacoast lighthouses, or may be shown from almost any type of inexpensive structure. The essentials of a light structure where keepers are not in residence as for all lights, are: best possible location dependent on physical conditions of the site, sufficient height for the location, a rugged support for the lantern, and a housing for the tanks of compressed gas or electric batteries from which the light is operated. Meeting these essentials are many types of structures—small tank houses surmounted by a short skeleton tower, a cluster of piles supporting a battery box and the lens, and countless other forms.

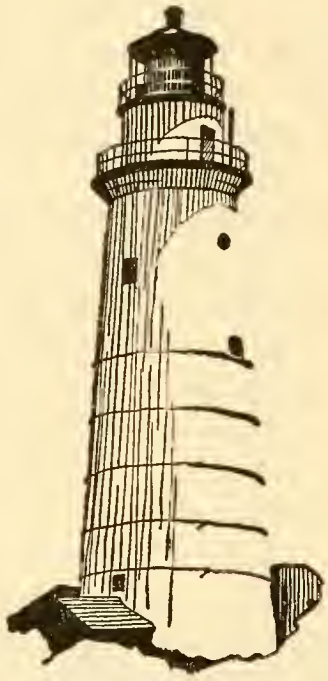
At the present time many of the lighthouses which were originally cared for by resident keepers are operated automatically, because of the availability of commercial electric current. There are also now a great many automatic lights on inexpensive structures, cared for through periodic visits of Coast Guard cutters or of attendants placed in charge of a group of such aids.

The recent introduction of much new automatic apparatus means that the relative importance of lights cannot be judged on the basis of whether or not they have resident keepers, for a number of powerful lights in towers of great height are now operated without continuous attention.

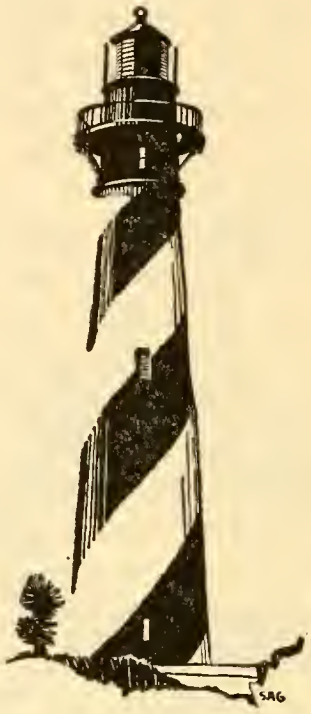
COLORING OF STRUCTURES

Color is applied to lighthouses and automatic light structures for the purpose of making them readily distinguishable from the background against which they are seen, and to distinguish one structure

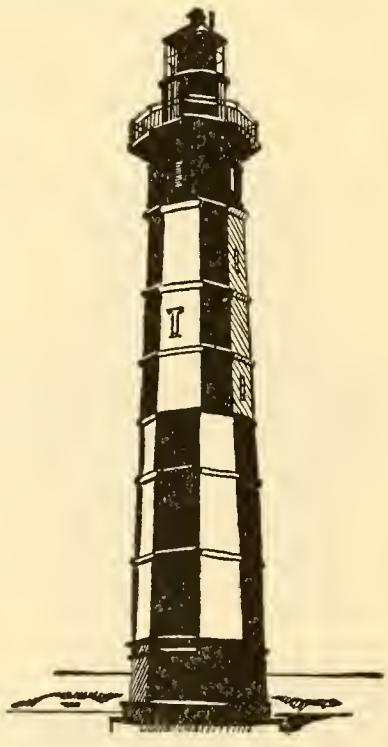
COLORING OF TYPICAL LIGHTHOUSES



BOSTON, MASS.



ST. AUGUSTINE FLA.



CAPE HENRY, VA.

TYBEE, GA.

from others in the same general vicinity. Solid colors, bands of color, and various other patterns are applied for these purposes.

Minor light structures are sometimes painted black or red, to indicate the sides of the channel which they mark, following the same lateral system used in the coloring of buoys. When so painted, red structures mark the right side of the channel, and black structures the left side of the channel, entering from seaward.

LIGHT CHARACTERISTICS

Lights are given distinctive characteristics so that one light may be distinguished from another, or as a means of conveying certain definite information. This distinctiveness is obtained by employing lights of various colors, by having lights that burn steadily, and others that flash at intervals of great variety. The principal "characteristics" employed for aids to navigation are shown on page 6.

COLORS

The three standard light colors used for lighted aids to navigation are white, red, and green.

LENGTH OF LIGHT PERIODS

By varying the length of the periods of light and darkness of any of the flashing or occulting characteristics, a great variety of characteristics may be obtained. Advantage is taken of this to secure the necessary distinctiveness between aids of a given area.

IDENTIFICATION OF LIGHTS

When making a landfall, the charts and the light lists should be consulted to learn the exact characteristics of the light or lights which it is expected will be first seen. When a light is observed, its color is noted and, by means of a watch or clock with a second hand, a note is made of the time required for the light to perform its full cycle of changes. If color, cycle, and number of flashes per cycle agree with the information in the light list, correct identification has been made. The light list should be examined to ascertain if any other light in the general locality might be seen and mistaken for the desired light. If there is doubt, a careful timing of the length of all flashes and dark intervals, for comparison with the light list, is usually conclusive.

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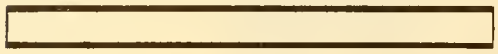
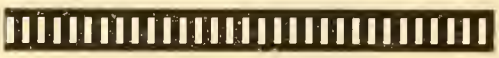
CHARACTERISTIC LIGHT PHASES

Illustration	Symbols and meaning		Phase description
	Lights which do not change color	Lights which show color variations	
	F.=Fixed-----	Alt.=Alternating.	A continuous steady light.
	F. Fl.=Fixed and flashing.	Alt. F. Fl.=Alternating fixed and flashing.	A fixed light varied at regular intervals by a flash of greater brilliance.
	F. Gp. Fl.=Fixed and group flashing.	Alt. F. Gp. Fl.=Alternating fixed and group flashing.	A fixed light varied at regular intervals by groups of 2 or more flashes of greater brilliance.
	Fl.=Flashing	Alt. Fl.=Alternating flashing.	Showing a single flash at regular intervals, the duration of light always being less than the duration of darkness. Shows not more than 30 flashes per minute.
	Gp. Fl.=Group flashing.	Alt. Gp. Fl.=Alternating group flashing.	Showing at regular intervals groups of 2 or more flashes.
	Qk. Fl.=Quick flashing.	----------	Shows not less than 60 flashes per minute.
	I. Qk. Fl.=Interrupted quick flashing.	----------	Shows quick flashes for about 4 seconds, followed by a dark period of about 4 seconds.
	S-L. Fl.=Short-long flashing.	----------	Shows a short flash of about 0.4 second, followed by a long flash of 4 times that duration.
	Occ.=Occulting.	Alt. Occ.=Alternating occulting.	A light totally eclipsed at regular intervals, the duration of light always equal to or greater than the duration of darkness.
	Gp. Occ.=Group occulting.	----------	A light with a group of 2 or more eclipses at regular intervals.

Light colors used and abbreviations: W=white, R=red, G=green.

HOW FLASHES ARE PRODUCED

The flashing lights of lighthouses and minor lights are produced in several ways. In some of the larger lights the flashes result from the rotation of the lenses in which various flash panels are incorporated. The use of electricity as the illuminant has also made it possible to produce flashes by means of timing devices which interrupt the flow of current or conceal the light source at definite intervals.

In those minor lights where acetylene gas is used, the flashes are produced by interrupting the flow of gas by means of a bellows-like device, each small charge of gas being ignited at the burner by a constantly burning nonluminous pilot flame.

Electricity is the illuminant now used in most of the larger lighthouses, electric incandescent lamps placed inside the larger sizes of lenses producing beams of as much as 5,000,000 candlepower where such brilliance is required. Lenses, which are aggregates of highly polished glass prisms, are assembled in a variety of types to produce the characteristics desired.

VISIBILITY OF LIGHTS

The theoretical visibility of a light in clear weather depends upon two factors, the height of the light above water, and its intensity or brilliance. The height controls what is known as the geographic range, while the intensity controls what is known as the luminous range.

As a rule, for the principal lights the luminous range is greater than the geographic, and the distance from which such lights are visible is limited by the earth's curvature only. Under some atmospheric conditions the glare or loom of these lights, and occasionally the light itself, may be visible far beyond the computed geographic range. On the other hand, and unfortunately more frequently, these distances may be lessened by fog, rain, snow, haze, or smoke.

Lights on inside waters, where their radius of usefulness is not great, are frequently of insufficient intensity to reach to the full limit of their geographic range.

SECTORS

Sectors of colored glass are placed in the lanterns of certain lighthouses to mark shoals or to warn mariners off the nearby land. Lights so equipped show one color from most directions and a different color or colors over definite arcs of the horizon indicated in the light lists and upon the charts. A sector changes the color of a light, when viewed from certain directions, but not the characteristic. For example, a flashing white light having a red sector, when viewed from within the sector, will appear flashing red.

Sectors may be but a few degrees in width, marking an isolated rock or shoal, or of such width as to extend from the direction of the deep water toward shore. Bearings referring to sectors are expressed in degrees as observed from a vessel toward the light.

In the majority of cases, water areas covered by red sectors should be avoided, the exact extent of the danger being determined from an examination of the charts. In some cases a narrow sector may mark the best water across a shoal. A narrow sector may also mark a turning point in a channel.

FOG SIGNALS

These signals form an important part of the equipment of many lighthouses situated in sections of the country where fog or low visibility is prevalent. Identification is made in the same manner as with lights. Each fog signal station is assigned a signal consisting of a definite number of blasts recurring at stated intervals. The sound or tone of the signal varying with the type of mechanism employed, also assists in identification. Fog signals are treated in greater detail on page 10.

RANGE LIGHTS

Two lights, located some distance apart, visible usually in one direction only, are known as range lights. They are so located that the mariner by bringing his ship into line with them, when they will appear one over the other, places his ship on the axis of the channel. If he steers his ship so that the lights remain continuously in line, he will remain within the confines of the channel. Entrance channels are frequently marked by range lights. The Delaware River and the St. Johns River on the Atlantic coast, and the Columbia River on the Pacific coast are examples of successive straight reaches marked in this manner.

The lights of ranges may be any of the three standard colors, and may also be fixed, flashing, or occulting, the principal requirement being that they stand out distinctly from their surroundings. Most range lights lose brilliance rapidly as a ship diverges from the range line. Ranges should be used only after a careful examination of the charts, and it is particularly important to determine for what distance the range line can be safely followed, this information not being obtainable from the lights themselves in all cases.

LIGHTSHIPS

Lightships serve the same purpose as lighthouses, being equipped with lights, fog signals, and radiobeacons. They take the form of ships only because they are placed at points where it would be impracticable to build lighthouses. Lightships mark the entrances to important harbors or estuaries, dangerous shoals lying in much frequented waters, and also serve as leading marks for both transoceanic and coastwise traffic.

COLOR OF LIGHTSHIPS

All lightships in United States waters, except Lake Huron Lightship, are painted red with the name of the station in white on both sides. Lake Huron Lightship is painted black with the name of the station painted in white on both sides. Superstructures are white; masts, lantern galleries, ventilators, and stacks are painted buff. Relief lightships are painted the same color as the regular station ships, with the word "RELIEF" in white letters on the sides.

RELIEF LIGHTSHIPS

These may be placed at any of the lightship stations, and, when practicable, will exhibit lights and sound signals having the characteristics of the station. Relief ships may differ in outward appearance from the regular station ships in certain minor details.

SIGNALS

The masthead lights, the fog signals, and the radiobeacon signals of lightships all have definite characteristics, so that each lightship may be distinguished from others and also from nearby lighthouses. As with lighthouses, details regarding these signals are shown briefly on charts and more completely in the light lists.

A lightship under way or off station will fly the International Code signal flags "PC" signifying lightship is not at anchor on her station. It will not show or sound any of the signals of a lightship, but will display the lights prescribed by the International or Inland Rules for a vessel of its class. While on station a lightship shows only the masthead light and a less brilliant light on the forestay, the latter serving to indicate the direction in which the ship is heading. By day the lightship will display the International Code signal of the station, whenever it appears that an approaching vessel does not recognize the lightship or requests the information. As lightships ride to a single anchor, the light on the forestay also indicates the direction of the current.

POWER PLANTS

United States lightships are self-propelled vessels capable of proceeding to and from their stations under their own power. By this means they also work back to their stations if driven off by storms, and also use their engines to relieve the strain on their moorings in severe weather. A number of lightships are Diesel propelled, some direct connected, others with geared drive, and still others with an electric motor connected to the propeller shaft and served by Diesel electric generating sets. Several ships still employ reciprocating steam engines, usually with oil-fired boilers.

Most lightships, when on station, derive power for the operation of their signals from Diesel driven auxiliaries. In the Diesel-electric ships, one or more generating sets are used for auxiliary purposes in accordance with the demand for power.

The names appearing on the sides of lightships are the names of the stations which the ships occupy at the time. Individual ships of the service are identified by permanent numbers. During a lifetime of 40 or 50 years a lightship may occupy a half-dozen stations, having the name of each in turn painted upon it.

FOG SIGNALS

Any sound-producing instrument operated in time of fog from a definite point shown on the charts, such as a lighthouse, lightship, or buoy, serves as a useful fog signal. To be effective as an aid to navigation, a mariner must be able to identify it and to know from what point it is sounded. The simpler fog signals are bells and whistles on buoys, and bells struck by hand generally at lighthouses. As such signals on buoys which are operated by the action of the sea do not produce sounds on a regular time schedule, positive identification is not always possible.

At most lighthouses and lightships, fog signals are operated by mechanical means and are sounded on definite time schedules, providing the desirable feature of positive identification.

The various types of apparatus employed for sounding fog signals are of interest to the mariner principally because each type produces distinctive sounds, familiarity with which assists in identification.

SIGNAL CHARACTERISTICS

These are composed of blasts and silent periods. A definite time is required for each signal to perform a complete cycle of changes. This time, stated in the light list is one of the means of identification. Where the number of blasts and the total time for a signal to complete a cycle is not sufficient for positive identification, reference may be

made to details in the light list regarding the exact length of each blast and silent interval.

The various types of fog signals differ in tone, and this facilitates the recognition of the respective stations. The type of fog signal apparatus for each station is stated in the light lists.

Diaphones produce sound by means of a slotted reciprocating piston actuated by compressed air. Blasts may consist of two tones of different pitch, in which case the first part of the blast is high and the last of a low pitch. These alternate-pitch signals are called "two-tone."

Diaphragm horns produce sound by means of a disc diaphragm vibrated by compressed air, steam, or electricity. Duplex or triplex horn units of differing pitch produce a chime signal.

Reed horns produce sound by means of a steel reed vibrated by compressed air.

Sirens produce sound by means of either a disc or a cup-shaped rotor actuated by compressed air, steam, or electricity.

Whistles produce sound by compressed air or steam emitted through a circumferential slot into a cylindrical bell chamber.

Bells are sounded by means of a hammer actuated by hand, by a descending weight, compressed gas, or electricity.

ELECTRONIC AIDS TO NAVIGATION

MARINE RADIOBEACONS

The marine radiobeacon system, effective for distances up to 200 miles and more, is an electronic system by means of which a navigator can determine position or lines of position quickly in practically any kind of weather. It makes use of radio transmitting stations (radiobeacons) and specially designed radio receivers equipped with a rotating coil antenna (radio direction finders).

Marine radiobeacons, installed at lighthouses, on lightships, and other charted locations, operate separately or as part of a group of two or three radiobeacons. Any one or all of a group of radiobeacons can be used by the navigator in determining position or lines of position.

Marine radiobeacons transmit radio signals on preselected frequencies of from 285 to 315 kilocycles which radiate in all directions. The signals are emitted as groups of dots and dashes or a series of short dashes. The arrangement of the groups of dots and dashes is selected to permit identification of individual radiobeacons transmitting signals on the same radio frequency.

The majority of Coast Guard radiobeacons transmit signals for 1 minute every 3 minutes during one or two 10-minute periods out of each hour in clear weather and for 1 minute every 3 minutes during periods of fog or low visibility. Some Coast Guard radiobeacons transmit signals 24 hours daily, for 1 minute every 3 minutes 24 hours daily, or for about 15 seconds twice every minute 24 hours daily.

In the radiobeacon system, a navigator uses the radio direction-finder to determine the direction or bearing of the signal transmitted from a radiobeacon. The general problems and practice of navigation when using radiobeacon bearings are the same as when using visual bearings on lighthouses or other charted objects. While both radiobeacon and visual bearings are available in clear weather, the former have the added important advantage of being available at greater distances and under all conditions of visibility.

The signal emitted by a radiobeacon follows a great circle course. When the distance to a radiobeacon is short, the bearing is plotted in the same manner as a bearing on a visual charted object. When the distance is greater than 50 miles, a correction usually must be applied to the radiobeacon bearing before plotting on a mercator chart. These corrections are found in Radio Bearing Conversion tables published in United States Navy Hydrographic Office publication H. O. 205 titled "Radio Navigational Aids."

While marine radiobeacons are specifically provided for the purpose of navigation, it should be noted that radio bearings for navigation can be obtained from any radio station which transmits identifying radio signals within the frequency range of the radio direction-finder and whose charted location is known or can be plotted.

Many Coast Guard radiobeacons are synchronized with sound fog signals at the station for distance finding. During fog, a group of two radio dashes, 1 second and from 3 to 5 seconds in length, are transmitted every 3 minutes coincident with sound signal blasts of corresponding length. When within audible range of the sound signal, distance from the station can be determined with any radio receiver capable of receiving radiobeacon signals by observing the time elapsed between hearing the radiobeacon and corresponding synchronized sound signal. The elapsed time in seconds divided by 5 for statute miles or 5.5 for nautical miles will give the distance from the station. The error of such observations should not exceed 10 percent.

The Coast Guard maintains and operates all marine radiobeacon stations along the coasts of the United States, its territories and possessions (185 in 1949). Complete information regarding these radiobeacons is given in the Coast Guard light list and United States Navy Hydrographic Office publication H. O. 205 titled "Radio Navi-

Section of Page of Radiobeacon Characteristics

Station		Operate on—		Signal characteristic transmitted
Latitude N.	Longitude W.	Kilocycles	Power [3]	
ATLANTIC COAST				
West Quoddy Head Light Station, Maine		288	C	— • — —
44 48.9	66 57.1			
Mount Desert Light Station, Maine		288	C	— • • •
43 58.1	68 07.7			
Matinicus Rock Light Station, Maine		294	C	• — — •
43 47.0	68 51.3			
Manana Island Fog Signal Station, Maine		300	B	— — — •
43 45.8	69 19.7			
Halfway Rock Light Station, Maine		312	B	— — —
43 39.4	70 02.2			
Portland Lightship, Maine		288	B	— • —
43 31.6	70 05.5			
Eastern Point Light Station, Mass		292	C	• — • —
42 34.8	70 39.9			
Boston Lightship, Mass		302	B	— — • •
42 20.4	70 45.5			
Canal Breakwater Light Station, Mass		292	C	• • —
41 46.5	70 29.8			
Cape Cod Light Station, Mass.[3]		302	A	— — • —
42 02.4	70 03.6			
Pollock Rip Lightship, Mass		314	A	— • • —
41 36.1	69 51.1			
Nantucket Shoals Lightship, Mass		314	A	— — — —
40 37.0	69 37.0			
Warning beacon			Special	— _ — _

DISTANCE FINDING STATIONS

SYNCHRONIZED RADIOBEACON AND SOUND SIGNALS

STATION, FREQUENCY IN K.C. AND CHARACTERISTIC OF RADIOBEACON SIGNAL		OFF MINUTES OF RADIOBEACON	OPERATING MINUTE OF RADIOBEACON
PARTRIDGE ID., CAN. 294 K.C.	RADIOBEACON	SILENT	58
	SOUND SIGNAL	23 23	53
WEST QUODDY HEAD 288 K.C.	RADIOBEACON	SILENT	52
	SOUND SIGNAL	24 24	53
MOUNT DESERT 288 K.C.	RADIOBEACON	SILENT	52
	SOUND SIGNAL	26 26	53
MATINICUS ROCK 294 K.C.	RADIOBEACON	SILENT	58
	SOUND SIGNAL	13 13 13 13	13 13 23
MANANA ISLAND 300 K.C.	RADIOBEACON	SILENT	52
	SOUND SIGNAL	36	53
HALFWAY ROCK 312 K.C.	RADIOBEACON	SILENT	52
	SOUND SIGNAL	64	53

gational Aids." Radiobeacon system charts showing the general locations and operating characteristics of Coast Guard radiobeacons, suitable for ready reference by posting near radio direction-finders, are available from the Coast Guard. Three charts are issued, one each for the Atlantic and Gulf, the Pacific, and the Great Lakes areas. A detail treatise on the radiobeacon system is contained in a separate Coast Guard publication on "Electronic Aids to Navigation."

LORAN

The term loran is derived by combining the first letters of LOng Range Aid to Navigation. The loran system, effective for distances up to 750 miles by day and 1,400 miles by night, is an electronic system by means of which a navigator can determine position or a line of position accurately and quickly in practically any kind of weather. It makes use of special radio transmitting stations on shore (loran transmitting stations), specially designed radio receivers with an electronic time-measuring device (loran receiver-indicator) and special charts or tables (loran charts or tables).

Loran transmitting stations, strategically located on shore, operate in pairs as part of a group of three or more loran transmitting stations separated at distances of from 200 to 600 miles. When the number of stations in a group exceeds two, the intermediate stations are paired with both adjacent stations. Any pair or all pairs of stations in a group of loran transmitting stations can be used by the navigator in determining position or lines of positions.

Loran transmitting stations transmit radio signals on preselected frequencies of 1750, 1850, 1900, or 1950 kilocycles which radiate in all directions. The signals are transmitted 24 hours daily. They are emitted as a series of pulses or short bursts of radio energy recurring at selected regular intervals of time. The use of pulse transmission of signals permits the identification of individual pulses on the same radio frequency and the measuring of time difference between reception of pulses from each station in a pair of loran transmitting stations.

In the loran system, the time difference of reception of signal pulses from a pair of loran transmitting stations is measured electronically and not the individual distances themselves. This measurement is known as a loran reading. There are many points at which the same loran reading is obtained but all these points fall along a smooth curve which is known as a loran line. Loran readings are showin as lines (loran lines) having geographic position on loran charts or a series of loran readings can be transposed to construct lines having geographic position by the use of loran tables.

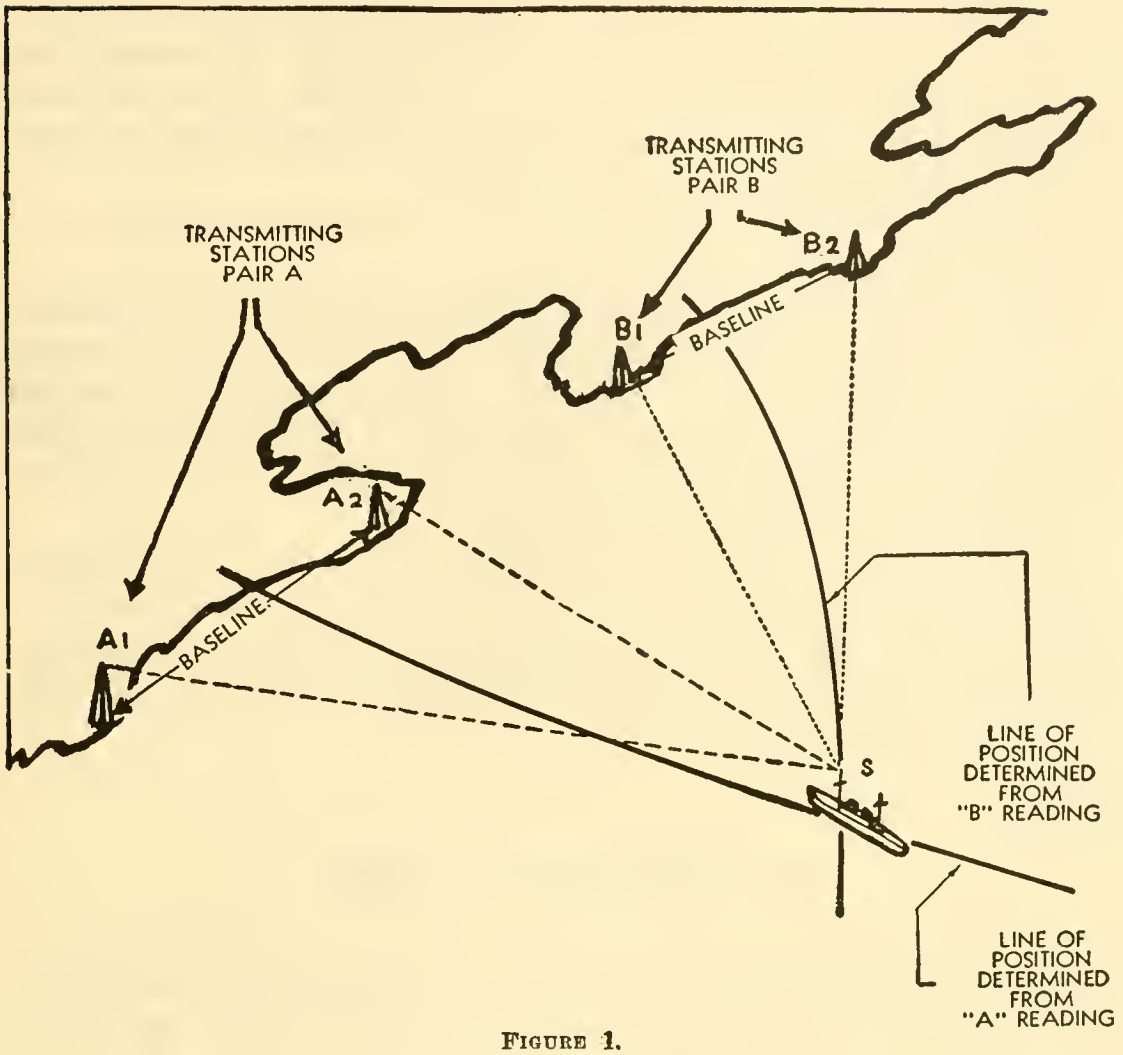


FIGURE 1.

Navigator aboard loran-equipped ship at "S" establishes "fix" by determining two lines of position, "A" and "B" by loran measurements.

Line of position "A" is found by measuring the time difference between signals received from transmitting stations A_1 and A_2.

Line of position "B" is found by measuring the time difference between signals received from transmitting stations B_1 and B_2.

The navigators fix is established at the point of intersection of the two lines of position.

The latitude and longitude of the navigator's position is determined from the loran data by using either the loran charts or loran tables.

The principle of the loran system differs from that of the radiobeacon system in that it is based on the difference in time of arrival of radio signals rather than the direction of arrival of radio signals as in the radiobeacon system. It is not necessary to know the charted locations of loran transmitting stations to use the loran system.

In the loran system a navigator uses the loran receiver indicator to obtain a loran reading and from it determine a line of geographic position between a pair of loran transmitting stations. The general problems and practice of navigation when using loran readings is the same as when using other means to determine lines of position. While lines of position obtained by loran readings or other means produce the

same general results, loran readings, obtainable in effective areas covered by the loran system, can be obtained with great accuracy and quickly day or night during all kinds of weather. Calculations by the navigator in using the loran system for position finding or determining lines of position are practically nil.

The diagram of figure 1 illustrates the basic principles of the determination of position by means of loran.

The Coast Guard maintains and operates 31 of the 37 loran transmitting stations now (1949) available for the navigation of all vessels and aircraft of the world. Coast Guard loran transmitting stations are located in the United States, Alaska, Hawaii, Greenland, Labrador, Newfoundland, Mariannas Islands, Marshall Islands, Iwo Jima, Okinawa, Japan, and the Philippine Islands.

Loran charts and tables for the individual areas now served by the loran system are obtainable for sale from the United States Navy Hydrographic Office Washington, D. C. A detail treatise on the loran system is contained in a separate Coast Guard publication on Electronic Aids to Navigation.

BUOYS

THE SIGNIFICANCE OF BUOYS

The primary function of buoys is to warn the mariner of some danger, some obstruction, or change in the contours of the sea bottom, and to delineate the channels leading to various points, so that he may avoid the dangers and continue his course safely. The utmost advantage is obtained from buoys when they are considered as marking definitely identified spots, for if a mariner knows his precise location at the moment and is properly equipped with charts, he can plot a safe course on which to proceed. Such features as size, shape, coloring, numbering, and signaling equipment of buoys, are but means to these ends of warning, guiding, and orienting the navigator.

THE LATERAL SYSTEM

The waters of the United States are marked for safe navigation by the lateral system of buoyage. This system employs a simple arrangement of colors, shapes, numbers, and light characteristics to show the side on which a buoy should be passed when proceeding in a given direction. The characteristics are determined by the position of the buoy with respect to the navigable channels as the channels are entered from seaward toward the head of navigation. As all channels do not lead from seaward, arbitrary assumptions must at times be made in order that the system may be consistently applied. The characteris-

UNITED STATES COAST GUARD

BUOYAGE OF THE UNITED STATES

Significance of Shapes, Coloring, Numbering, and Light Characteristics

Symbols shown adjacent to Buoys are those used on Charts to indicate such Aids

LATERAL SYSTEM

PORT SIDE
(Entering from Seaward)

Marks port side of channels and obstructions which must be passed on port hand
Color: BLACK
Numbering: ODD. (Does not apply to Mississippi River System)
Shape: CAN. (Lighted buoys, sound buoys, and spar buoys, have no shape significance)
Color of Light: WHITE OR GREEN
Light Phase Characteristics: (Does not apply to Mississippi River System)

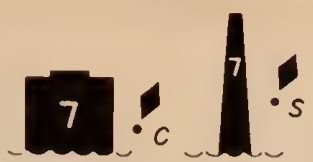
FLASHING

OCCULTING

QUICK FLASHING

Marking important turns, wrecks, etc., where particular caution is required.

Lighted



Can Spar

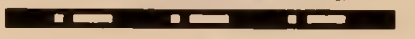
Unlighted Bell

Unlighted Whistle

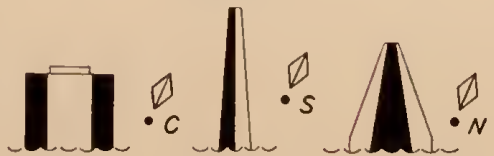
MID-CHANNEL
(Entering from Seaward)

Marks Mid-channel
Color: BLACK AND WHITE VERTICAL STRIPES
Numbering: NONE. May be lettered
Shape: NO SHAPE SIGNIFICANCE
Color of Lights: WHITE ONLY
Light Phase Characteristics:

SHORT-LONG FLASHING



Lighted

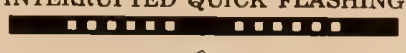


Can Spar Nun

JUNCTION
(Entering from Seaward)

Marks junctions and obstructions which may be passed on either side. Preferred channel is indicated by color of top hand.
Color: RED AND BLACK HORIZONTAL BANDS
Numbering: NONE. May be lettered
Shape: CAN OR NUN ACCORDING TO COLOR OF TOP BAND. (Lighted buoys, sound buoys, and spar buoys have no shape significance)
Color of Lights: WHITE, RED, OR GREEN
Light Phase Characteristics:

INTERRUPTED QUICK FLASHING



Lighted

Where preferred channel is to STARBOARD the topmost hand is BLACK

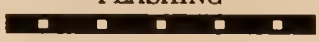
Where preferred channel is to PORT the topmost hand is RED

Can Spar Spar Nun

STARBOARD SIDE
(Entering from Seaward)

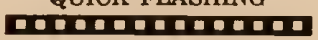
Marks starboard side of channels and obstructions which must be passed on starboard side
Color: RED
Numbering: EVEN. (Does not apply to Mississippi River System)
Shape: NUN. (Lighted buoys, sound buoys, and spar buoys have no shape significance)
Color of Light: WHITE OR RED
Light Phase Characteristics: (Does not apply to Mississippi River System)

FLASHING



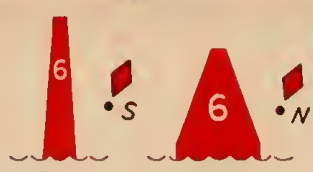
OCCULTING

QUICK FLASHING



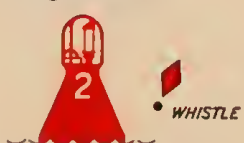
Marking important turns, wrecks, etc., where particular caution is required.

Lighted



Spar Nun

Unlighted Bell



Unlighted Whistle

BUOYS HAVING NO LATERAL SIGNIFICANCE

Color: AS SHOWN. Numbering: NONE. May be lettered. Light Phase Characteristics: Color of Lights: ANY EXCEPT RED OR GREEN

FIXED

Special Purpose

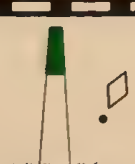
Quarantine Anchorage

FLASHING

Anchorage

OCCULTING

Fish Net



Dredging

tics of buoys are based on the assumption that proceeding in a southerly direction along the Atlantic coast, in a northerly and westerly direction along the Gulf coast, in a northerly direction on the Pacific coast, and in a northerly and westerly direction on the Great Lakes is proceeding from seaward. On the Intracoastal Waterway proceeding in a general southerly direction along the Atlantic coast, and in a general westerly direction along the Gulf coast is considered as proceeding from seaward. On the Mississippi and Ohio Rivers and their tributaries the aids to navigation characteristics are determined as proceeding from sea towards the head of navigation although local terminology describes "left bank" and "right bank" as proceeding with the flow of the river.

SPECIAL PURPOSE BUOYS

In addition to the lateral system of buoyage, several special purpose buoyage characteristics, which have no lateral significance, are utilized to mark dredging areas, quarantine areas, fish net areas, anchorages, race courses, experiments or tests, etc.

TYPE OF BUOYS

The buoyage system adopted for the waters of the United States consists of several different types of buoys, each kind designed to serve under definite conditions. Broadly speaking, all buoys serve as daymarks, those having lights are also available for navigation by night, and those having sound signals are also more readily located in time of fog as well as by night. The following are the principal general types.

Spar Buoys.—Large logs, trimmed, shaped, and appropriately painted. Buoys of the same spar shape are also constructed of steel plates.

Can and Nun Buoys.—Buoys built up of steel plates having the distinctive shapes designated by these names.

Bell Buoys.—Steel floats surmounted by short skeleton towers in which the bells are fixed. Most bell buoys are sounded by the motion of the buoy in the sea. In a few buoys the bells are struck by compressed gas or electrically operated hammers.

Gong Buoys.—Similar in construction to bell buoys, but sounding a distinctive note because of the use of sets of gongs each gong of which has a different tone.

Whistle Buoys.—These buoys provide a sound signal which is useful at night and also during fog and low visibility. As the whistle mechanism is operated by the motion of the buoy in the sea, these buoys are used principally in exposed locations.

A type of sound buoy is also in use in which a HORN is sounded at regular intervals by mechanical means.

LIGHTED BUOYS.—A metal float on which is mounted a short skeleton tower at the top of which the lantern is placed. Tanks of compressed acetylene gas, or electric batteries, on which the light is operated, are placed in the body of the buoy below the water level.

COMBINATION BUOYS.—These are buoys in which a light and a sound signal are combined, such as a lighted bell buoy, lighted gong buoy, lighted whistle buoy, or lighted horn buoy.

COLORING OF BUOYS

All buoys are painted distinctive colors to indicate their purpose or, in the lateral system, the side on which they should be passed. The meaning of lateral system buoys, when proceeding from seaward (see Lateral System) is indicated by their colors as follows:

BLACK BUOYS mark the port (left) sides of channels, or the location of wrecks or obstructions which must be passed by keeping the buoy on the port (left) hand.

RED BUOYS mark the starboard (right) sides of channels, or the location of wrecks or obstructions which must be passed by keeping the buoy on the starboard (right) hand.

RED AND BLACK HORIZONTALLY BANDED BUOYS mark junctions in the channel, or wrecks or obstructions which may be passed on either side. If the topmost band is black, the preferred channel will be followed by keeping the buoy on the port (left) hand. If the topmost band is red, the preferred channel will be followed by keeping the buoy on the starboard (right) hand.

(NOTE.—When proceeding toward seaward, it may not be possible to pass on either side of these buoys, and the chart should always be consulted.)

BLACK AND WHITE VERTICALLY STRIPED BUOYS mark the fairway or midchannel and should be passed close to, on either side.

The meaning of special-purpose buoys is indicated by their colors as follows:

White buoys mark anchorage areas.

Yellow buoys mark quarantine anchorage areas.

White buoys with green tops are used in connection with dredging and survey operations.

White and black alternate horizontally banded buoys mark fish net areas.

White and international orange buoys alternately banded, either horizontally or vertically, are for special purposes to which neither the lateral-system colors nor the other special-purpose colors apply.

Yellow and black vertically striped buoys are used for seadrome markings and have no marine significance.

NUMBERING OF BUOYS

Most buoys are given numbers, letters, or combinations of numbers and letters which are painted conspicuously upon them. These markings facilitate identification and location of the buoys on the charts.

All solid-colored red or black buoys, except those in the Mississippi River aids to navigation system, are given numbers or combinations of numbers and letters. Other colored buoys may be given letters. Numbers increase from seaward and are kept in approximate sequence on both sides of a channel by omitting numbers where required. Odd numbers are used only on solid-black buoys. Even numbers are used only on solid-red buoys. Numbers followed by letters are used on solid-colored red or black buoys when a letter is required so as not to disturb the sequence of numbering or on important buoys, particularly those marking isolated offshore dangers. An example of the latter case would be a buoy marked "1DR" which in this instance the number has the usual significance, while the letters "DR" indicate the place as Duxbury Reef. Letters without numbers are applied in some cases to black and white vertically striped buoys, red and black horizontally banded buoys, solid-yellow buoys, and other buoys not solid colored red or black.

In the Mississippi River system, unlighted buoys are not numbered, while the numbers on lighted buoys have no lateral significance but indicate the number of miles from a designated point.

SHAPES OF BUOYS

In order to provide ready identification, certain unlighted buoys are differentiated by shape.

Red Buoys, or Red and Black Horizontally Banded Buoys with the topmost band red are conical shaped and called nun buoys.

Black Buoys, or Red and Black Horizontally Banded Buoys with the topmost band black are cylindrical shaped and called can buoys.

Black and White Vertically Striped Buoys may be either nun or can buoys. The shape has no significance in this case.

Full reliance should not be placed on the shape of an unlighted buoy alone. Charts and light lists should be consulted to ascertain the significance of unlighted buoys as determined by their colors.

Lighted Buoys, Sound Buoys, and Spar Buoys are not differentiated by shape to indicate the side on which they should be passed. Since no special significance is attached to the shapes of these buoys, their purpose is indicated by the coloring, numbering, or light characteristics.

COLOR OF LIGHTS

Red lights on buoys are used only on red buoys or red and black horizontally banded buoys with the topmost band red. Green lights on buoys are used only on black buoys or red and black horizontally banded buoys with the topmost band black. White lights on buoys are used on any color buoy. No special significance is attached to a white light on a buoy, the purpose of the buoy being indicated by its color, number, or its light phase characteristic.

REFLECTORS

Many unlighted buoys are fitted with reflectors. These greatly facilitate the locating of the buoys at night by means of a searchlight. Reflectors may be white, red, or green, and have the same significance as lights of these colors.

LIGHT PHASE CHARACTERISTICS

Flashing Lights (flashing at regular intervals and at the rate of not more than 30 flashes per minute) are placed only on black buoys, red buoys, or special purpose buoys.

Quick Flashing Lights (not less than 60 flashes per minute) are placed only on black buoys and on red buoys, at points where it is desired to indicate that *special caution* is required, as at sharp turns or sudden constrictions, or where used to mark wrecks or dangerous obstructions which must be passed only on one side.

Interrupted Quick Flashing Lights (the groups consisting of a series of quick flashes, with dark intervals of about 4 seconds between groups) are placed only on buoys painted with red and black horizontal bands, at points where it is desired to indicate junctions in channels, or wrecks or obstructions which may be passed on either side.

Short-Long Flashing Lights (groups consisting of a short flash and a long flash, the flashes recurring at the rate of about eight per minute) are placed only on buoys painted in black and white vertical stripes, at points where it is desired to indicate fairways or midchan-

nels and should be passed close to, on either side. The lights are always white.

The lights of buoys are operated by means of acetylene gas supplied from cylinders stored in the body of the buoy and piped to a flashing mechanism in the base of the lantern, or by means of electricity supplied from batteries stored in the buoy body in the same manner as the acetylene cylinders.

In order that lighted buoys may function for a reasonably long period of time without requiring a replenishment of the gas supply or a replacement of the batteries, the length of the light flashes as compared with the intervening periods of darkness is made quite short. Buoys at isolated points frequently function for 6 months or more without attention.

DAYBEACONS

There are many aids to navigation which are not lighted. Structures (not buoys) of this type are called daybeacons. They vary greatly in design and construction,[1] depending upon their location, and the distance to which they must be seen. A daybeacon may consist of a single pile with a daymark at the top, a spar with a cask at the top, a slatted tower, or a structure of masonry. Daybeacons are colored, as are lighthouses, to distinguish them from their surroundings and to provide a means of identification. Daybeacons marking the sides of channels are colored and numbered in the same manner as buoys and minor light structures; red indicating the right side entering, and black the left side entering. Many daybeacons are also fitted with reflectors to facilitate locating them at night by means of a searchlight.

INTRACOASTAL WATERWAY

DEFINITION

The Intracoastal Waterway, to which is applied the system of marking about to be described, is that comparatively shallow channel lying parallel to and extending along the Atlantic and Gulf coasts from Chesapeake Bay to the Mexican border. The special marking is applied to the so-called "inside route" proper and to those portions of all connecting waterways which must be crossed or followed in order to make a continuous passage.

DISTINCTIVE MARKING

All buoys, daybeacons, and light structures marking the Intracoastal Waterway have some portion of them painted yellow. This

[1] A constant effort is being made to standardize daybeacon markings which have become established by custom over many years.

is the distinctive coloring adopted for the Waterway. Buoys have a band of yellow at the top, daybeacons have a band or border of yellow, and light structures are similarly painted.

The coloring and numbering of buoys and daybeacons, and the color of the lights on buoys and on light structures is on the same lateral system as that prevailing in other waterways. The basic rule is that RED buoys and daybeacons are on the right-hand side of the channel when proceeding from Chesapeake Bay toward Mexico, and BLACK buoys and daybeacons are on the left-hand side of the channel when proceeding in the same direction. This rule is applied in a uniform manner from one end of the Intracoastal Waterway to the other, regardless of the widely differing compass headings of the many sections, and the fact that rivers and other waterways marked on the seacoast system are sometimes followed.

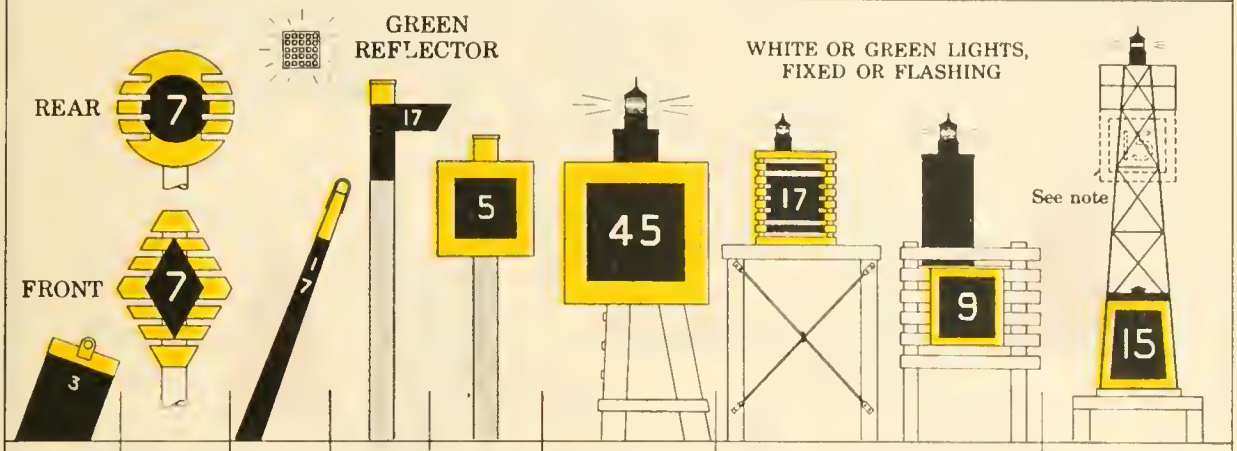
Numbering of Intracoastal Waterway aids follows the basic rule, numbers increasing from Chesapeake Bay toward Mexico. Aids are numbered in groups, usually not exceeding 200; numbering begins again at "1" at certain natural dividing points.

Lights on buoys follow the standard system of red or white lights on red buoys, and green or white lights on black buoys. The color of the lights on fixed structures also follow this general rule. Range lights, not being lateral markers, may be any of the three standard colors.

DUAL MARKING

In order that vessels may readily follow the Intracoastal Waterway route where it coincides with another waterway such as an important river marked on the seacoast system, special markings are employed. These special markings are applied to the buoys or other aids which mark the river or waterway for other traffic. The special marks consist of a yellow square and a yellow triangle, painted on a conspicuous part of the dual-purpose aid. The yellow square, in outline similar to a can buoy, indicates that the aid on which it is placed should be kept on the left hand when following the Intracoastal Waterway from Chesapeake Bay toward Mexico. The yellow triangle, in outline similar to a nun buoy, indicates that the aid on which it is placed should be kept on the right hand when following the Intracoastal Waterway from Chesapeake Bay toward Mexico. By this marking, the mariner approaching a body of water such as the Savannah River, and knowing that he must follow it for some distance before again entering a dredged cut of the Intracoastal Waterway, knows that his course lies along such buoys or other aids as are specially marked in yellow. He determines the side of his vessel on

TYPES OF AIDS TO NAVIGATION
INTRACOASTAL WATERWAY

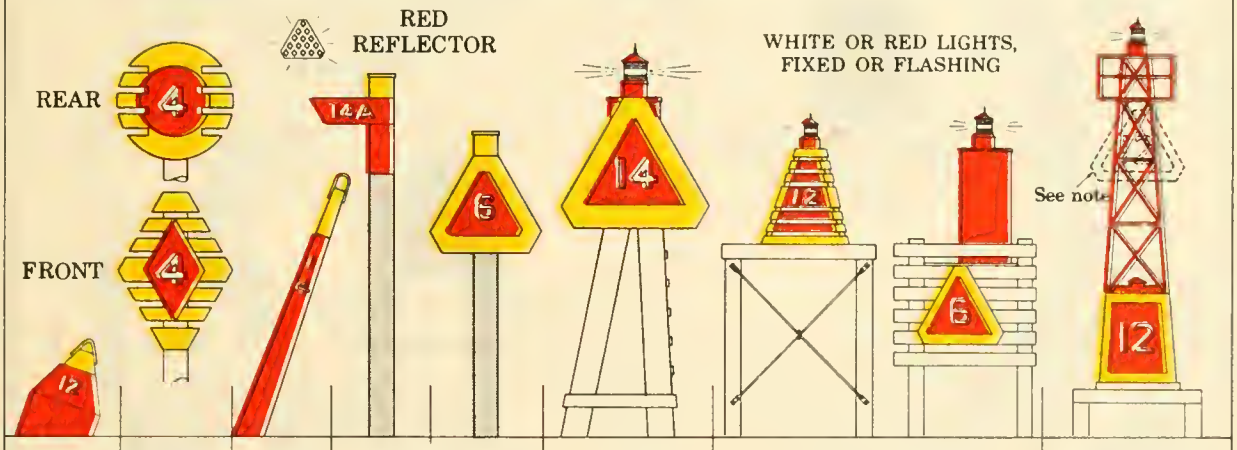


SPECIAL (S) CAN BUOY	RANGES ROUND, OVAL OR DIAMOND	SPAR BUOY 2nd.-4th. Class	DAYBEACONS Pointer	DAYBEACONS Daymark	3 PILE DOLPHIN	SLATTED, PILE STRUCTURES	SKELETON STRUCTURES
C "3"	"7" "7"	S "7"	"17"	"5"	Fl 2sec "45"	Fl G 5sec "17" F "9"	F G "15"

Supporting Structure may be painted White or Aluminum.

Note:- Daymark (shown dotted) added where needed. Border and number on Daymark where used.

PORT Side of channel (Black with Odd Numbers) entering from north and east and traversed to south and west respectively.



SPECIAL (S) NUN BUOY	RANGES ROUND, OVAL OR DIAMOND	SPAR BUOY 2nd.-4th. Class	DAYBEACONS Pointer	DAYBEACONS Daymark	3 PILE DOLPHIN	SLATTED, PILE STRUCTURES	SKELETON STRUCTURES
R N "12"	R "4" R "4"	R S "4"	R "14 A"	R "6"	Fl 2sec "14"	Fl R 5sec "12" F "6"	F R "12"

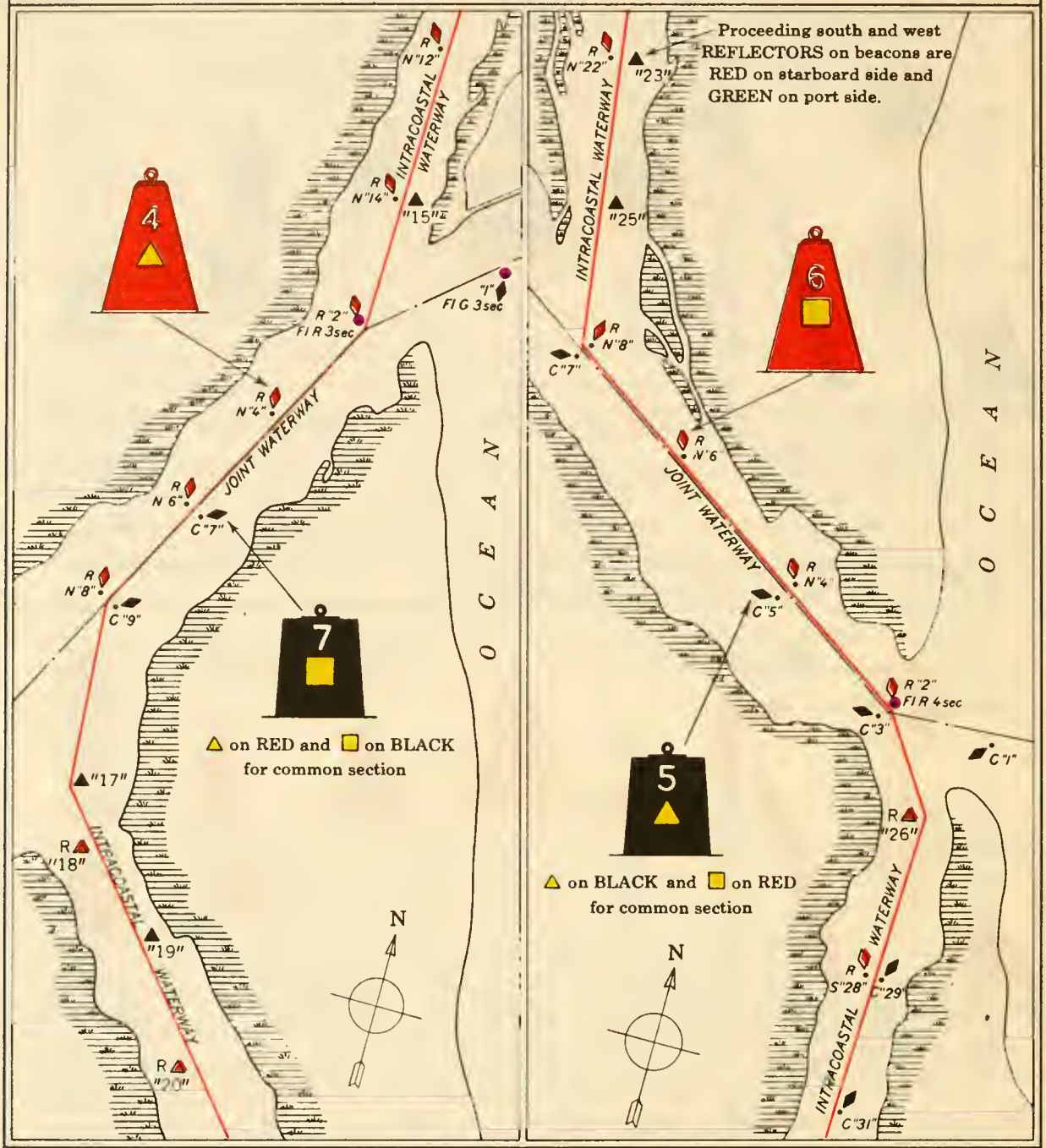
Supporting Structure may be painted White or Aluminum.

Note:- Daymark (shown dotted) added where needed. Border and number on Daymark where used.

STARBOARD Side of channel (Red with Even Numbers) entering from north and east and traversed to south and west respectively.

THE ICW AIDS ARE CHARACTERIZED BY THE YELLOW BORDER

ILLUSTRATING THE SYSTEM OF DUAL PURPOSE MARKING WHERE THE ICW AND OTHER WATERWAYS COINCIDE



SKETCH A:

ICW joins another waterway, which is numbered from seaward, at buoy No. 2 and is common with it to buoy No. 9. ICW numbers and yellow borders are omitted in this section but the △ or □ is used on the regular aids to designate the ICW.

SKETCH B:

ICW joins another waterway at buoy No. 8 and is common with it to buoy No. 3. This section is numbered in the opposite direction to that of the ICW. The ICW numbers and yellow borders are omitted from the regular aids but a △ or □ is shown to designate the ICW.

which these aids should be passed by the shape of the yellow marks, bearing always in mind the basic direction of his travel.

Where coincidental marking is employed, the mariner following the Intracoastal Waterway disregards the color and shape of the aid on which the mark is placed, being guided solely by the shape of the yellow mark. Can buoys of the seacoast system may have painted upon them yellow triangles or yellow squares, depending on whether the waterway which they mark is followed in the direction of the sea or in the direction of its headwaters, as the Intracoastal Waterway is followed in the direction of Mexico. Mariners not traversing the Intracoastal Waterway entirely disregard the special yellow markings.

SYMBOLS EMPLOYED UPON CHARTS

In order that mariners may derive the maximum use from navigational aids, they are shown upon the various nautical charts. In this manner, mariners are apprised of the various aids which they may expect to pass, and may plot any bearings which they may take for the purpose of determining their position.

Upon the charts the aids are shown by means of a series of conventional symbols to which are appended various abbreviations giving condensed information regarding the aids. The principal symbols and abbreviations are shown on Plate I, following page 16. The meaning of the various abbreviations are shown on page 6.

LIGHT LISTS

Light lists, describing the aids to marine navigation maintained by or under the authority of the United Staes Government, are published by the Coast Guard. Revised editions appear each year. The following volumes are issued:

Light List, Atlantic and Gulf Coasts (St. Croix River, Maine, to the Rio Grande, including the U. S. West Indian Islands).
Light List, Great Lakes (United States and Canada).
Light List, Mississippi River (and Tributaries).
Light List, Pacific Coast (United States; Alaska; Canada; Hawaiian and outlying Pacific islands).
Light List, Intracoastal Waterway.

Light lists are issued to the public on a sales basis. Copies may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., or from sales agents located in the principal ports. A list of sales agents is published quarterly in the Weekly Notice to Mariners.

PURPOSE

Light lists are compiled and published to provide mariners with more complete details regarding aids to navigation than are to be found on the charts.

ARRANGEMENT

Aids are listed in geographic order and in tabular form. Sea-coast aids for a given district are listed first. These are followed by main-channel aids in bays, harbors, and important rivers. Next are listed the aids in the less important tributaries. The information is classified as follows:

Name.—This is the official name of the aid or its station, and is to be preferred to local names which have become associated with certain aids.

Location.—The brief description of the location enables the mariner to find the aid on the chart, to identify it as it is approached, and to know in what depth of water it is located if not on land. The latitude and longitude of the more important lights is stated to assist in referring to charts.

Character and period of light.— Under this heading is stated the color of all lights, whether they are fixed, flashing, or occulting, and if flashing or occulting the time required for the mechanism to perform a complete cycle. Also indicated in this column is the fact that certain lights are unwatched.

Height of light above water.—From this mariners may calculate the distance to which a lighthouse will probably be seen in the daytime. In conjunction with the candlepower, it also indicates the approximate range of visibility by night.

Miles seen.—Indicates the distance to which a light may be expected to be seen under normal conditions, the height of the light and its candlepower having been taken into consideration. The figures used are based upon the observer's eyes being 15 feet above sea level. Visibility for other heights may be computed with the aid of a supplementary table published in the front of each light list.

Candlepower.—This serves as a rough gage of the distance to which a light may be seen, and indicates the relative brilliance of lights in the same general locality. In the case of a light of alternating colors it indicates the relative distances to which each color will be visible.

Apparatus and illuminant.—Of use primarily to maintenance personnel of the Coast Guard.

1807	*CHESAPEAKE LIGHT-SHIP.* Occ. W., 4 sec. Radiobeacon. Distance-Finding Station.	In 63 feet, 15 miles 78° from Cape Henry Lighthouse, off entrance to Chesapeake Bay. 36 58.7 75 42.2	66	14	1807	16,000 500 mm e	Light 2 sec., eclipse 2 sec. Fixed white light shown if occulting light inoperative. Riding light, F. W. 250 cp., on forestay. **DIAPHONE**, two-tone, air; blast 3 sec., silent 27 sec. Bell, hand, if diaphone is disabled. **RADIOBEACON**: Transmits on 312 kc, groups of dot, 2 dashes, dot. (•▬▬•).	Red hull "CHESAPEAKE" on sides; tubular mast with lantern and gallery. See p. 7. 1st-cl. nun station buoy lettered $\frac{C}{LS}$ 600 yards 0° from lightship. 1928 Code Flag signal and radio call NNBF. Storm warning signals displayed during day time. **DISTANCE-FINDING STATION.** For method of operation see p. 11.
1808	CAPE HENRY Gp. Fl. W., R. sector, 20 sec. 3 flashes. Radiobeacon. Distance-Finding Station. (Chesapeake Bay, see No. 1867) (Continuation of seacoast, see No. 2699.6)	On cape, south side of entrance to Chesapeake Bay. 36 55.6 76 00.4	157	19	1808	W. 160,000 R. 50,000 1 e	Flash 1 sec., eclipse 2 sec., flash 1 sec., eclipse 2 sec., flash 7 sec., eclipse 7 sec. Red from 154° to 233°, covers shoals outside Cape Charles and Middle Ground inside of bay. **DIAPHONES**, 2, air: Horns point 77° and 333°, blast 2 sec., silent 18 sec. **RADIOBEACON**: Transmits on 290 kc, groups of dash, dot, dash (▬•▬). Antenna lead-in 310 feet 38° from light tower.	Octagonal pyramidal tower; upper and lower half of each face alternately black and white. 1791 170 1881 **DISTANCE-FINDING STATION.** For method of operation see p. 10.

Light characteristics.—Additional details giving the exact length of all periods of light and darkness. Information regarding colored sectors is noted here.

Fog signal.—Includes details regarding the type and characteristics of fog signals. Radiobeacon operating characteristics are also stated in brief under this heading, more complete details being given in a table in another part of the list.

Structure, vessel, or buoy.—These brief descriptions of the shape and coloring of the various aids assist in location and identification.

Established, rebuilt.—These dates serve as an indication of any recent change in the outward appearance of an aid.

Top of lantern above ground.—This information is provided to enable a mariner to compute a vertical danger angle. With a sextant, the angle subtended by the top of the lantern and the base of the tower is measured. Knowing this angle, and the height, which becomes one side of a triangle, the length of another side of a triangle can be computed. The length of this second side is the distance between the observer and the lighthouse.

NOTICE TO MARINERS

The Coast Guard disseminates information concerning establishments, changes, and discontinuances of aids to navigation in the United States, its territories, and possessions by means of Notices to Mariners. Reports of channel conditions, obstructions, menaces to navigation, danger areas, etc., are also included in Notices to Mariners. These notices are essential to all navigators for the purpose of keeping their Light Lists, nautical charts, Coast Pilots, and other nautical publications currently corrected.

Local Notices to Mariners are issued by each district commander. They include changes and deficiencies in aids to navigation within the area of each Coast Guard district. These notices are published as required, which in most districts is daily. If only local information is required, the notices issued by the various district commanders will serve the needs of local navigators. They may be obtained, free of charge, by making application to the appropriate district commander.

Weekly Notices to Mariners (North American-Caribbean Edition) are prepared jointly by the Coast Guard and the Navy Hydrographic Office, and published weekly by the Navy Hydrographic Office. They include changes in aids to navigation in assembled form for all Coast Guard districts, except the Ninth Coast Guard District (Great Lakes), and the Second Coast Guard District (Mississippi River system). Foreign marine information in the

Section of Page of NOTICE TO MARINERS

(2716) **NORTH CAROLINA—Cape Fear River—Light established.**—Dram Tree Point Light 56, showing *flashing red* every *4 seconds*, flash *0.4 second*, eclipse *3.6 seconds*, of 11 candlepower, has been established 950 yards 330°30′ from the westernmost tank south of Dram Tree Point. The light is exhibited 16 feet above water on a red slatted pile structure.

Approx. position: 34°11′50″ N., 77°57′25″ W.

(N. M. 21, May 21, 1949.)

(N. M. 77, C. G., Norfolk, May 3, 1949.)
U. S. Coast Survey Chart **425.**
U. S. Light List, Atlantic Coast, 1948, No. **2316.5.**
U. S. Coast Pilot, Section D, 1948, page 188.

(2621) **CALIFORNIA—Los Angeles-Long Beach Harbors—Light and fog signal discontinued—Light, fog signal and radiobeacon established.**—1. Long Beach Entrance West Light and the fog signal have been discontinued.

Approx. position: 33°43′23″ N., 118°11′10″ W.

2. Long Beach Harbor Light, showing *flashing white* every *5 seconds*, flash *1 second*, eclipse *4 seconds*, of 140,000 candlepower, has been established on the east end of the Middle Breakwater. The light is exhibited 50 feet above water on a white rectangular tower on a white concrete building.

A fog signal consisting of a diaphragm horn sounding *1 blast* every *20 seconds*, blast *3 seconds*, silent *17 seconds*, has been established at the light.

A radiobeacon (Class D) has been installed on the light structure, and transmits on 296 kcs a group of 0.5 second dashes for 13.5 seconds, silent 1.5 seconds. The radiobeacon operates continuously only when the fog signal is in operation.

(Supersedes N. M. 8 (974) of 1949.)

(N. M. 20, May 14, 1949.)

(N. M. 17, C. G., Long Beach, Apr. 22, 1949.)
H. O. Charts **Aneh. N, 5196, 5760.**
U. S. Coast Survey Charts **5147, 5148, 5143, 5101, 5020, 5002,** 9000.
U. S. Light List, Pacific Coast, 1949, No. 124 and page 13.
U. S. Coast Pilot, Pacific Coast, 1942, page **66.**
H. O. Pub. 205, 1947, No. **2157.5.**

North American-Caribbean area is also included in these notices. These notices are intended for mariners and others who have a definite need for them in connection with extended seagoing activities or those operating in several Coast Guard districts. These notices may

be obtained, free of charge, by making application to Commandant (OAN), U. S. Coast Guard, Washington, D. C.

Weekly Notices to Mariners of the Great Lakes are prepared jointly by the Coast Guard and the Navy Hydrographic Office, and published weekly at the Navy Branch Hydrographic Office, Cleveland, Ohio. These notices may be obtained, free of charge, by making application to the Navy Branch Hydrographic Office, Cleveland, Ohio.

Weekly Notices to Mariners (World Edition) are published weekly by the Navy Hydrographic Office. These notices contain all the information published in the North American-Caribbean Edition and also similar information collected from other maritime countries. Requests for these notices should be addressed to the Navy Hydrographic Office, Department of the Navy, Washington 25, D. C.

Marine Broadcast Notices to Mariners are made by the Coast Guard through Coast Guard or Naval radio stations to report deficiencies and changes in aids to navigation of importance. Radio stations broadcasting marine information are listed in "Radio Aids to Navigation (HO–205)" and "Hydrographic Bulletins" published by the Navy Hydrographic Office.

Single copies of Notices to Mariners may be obtained or consulted at the offices of the United States Coast Guard district commanders, the Coast and Geodetic Survey district offices, the Navy branch hydrographic offices, or other agencies distributing marine information.

EARLY HISTORY

The maintenance of aids to marine navigation is one of the oldest Federal functions, the work of erecting and maintaining lighthouses being provided for at the first session of Congress by act of August 7, 1789 (the ninth law enacted by Congress). Twelve lighthouses which had previously been built by the Colonies were ceded to the new Federal Government, and became the nucleus of a system of aids to navigation which over a period of 160 years has been increased to a present total of over 36,000.

Federal maintenance of aids to navigation was first carried on under the direct supervision of the Secretary of the Treasury. Somewhat later, when the duties of the Secretary of the Treasury had greatly increased, administration of the aids to navigation was delegated to the Commissioner of the Revenue. In 1820, the superintendence of the lighthouse establishment was assigned to the fifth auditor of the Treasury, and in 1845 again transferred, this time to the Revenue Marine Bureau, an organization which later became the Coast Guard.

The collectors of customs through all this period served as local superintendents of lighthouses.

A Lighthouse Board was created in 1852, to administer the constantly expanding service, being composed of officers of the Army and the Navy, and of civilian scientists. In 1903 the Lighthouse establishment was transferred from the Treasury Department to the newly created Department of Commerce and Labor and in 1910, the Lighthouse Board was superseded by the Bureau of Lighthouses in the Department of Commerce. On July 1, 1939, the Lighthouse Service was consolidated with the United States Coast Guard.

The United States Coast Guard today maintains over 36,000 aids to marine navigation. The greater number of these are lighthouses, automatic lights, and buoys. There are also about 185 radiobeacons, 28 lightship stations, and about 2,100 fog signals, including those on buoys.

BRIEF HISTORY OF BUOYAGE

Buoyage of navigable waterways in this country was undertaken at least as early as 1767, when, according to available records, buoys were in use in the Delaware River. The earliest types were simply solid wooden spars or were built up of staves, similar to a barrel. This stave construction was employed in small buoys used near Boston about 1808, but these gave way to spar buoys about 1820, supplemented by iron buoys in 1850. A marked improvement was effected in 1900 when tall can and nun buoys were introduced. In 1881, the first lighted buoy, burning oil gas, was put into service outside New York Harbor. Electricity was employed from 1888 to 1903 in the Gedney Channel in New York lower bay. Current for these buoys was supplied through cables from shore, but this system proved impractical. Buoys lighted by compressed acetylene gas stored in tanks within the buoy itself, the type of lighted buoy in general use today, were introduced in 1910. Bell buoys, in which the bell is struck by clappers actuated by the rolling of the buoy in the sea, have been in service since 1885; and now buoys are also in service in which the bell is struck at regular intervals by a mechanism operated by compressed gas. Whistle buoys, the whistle sounded through motion of the buoy in the sea, have been employed since 1876. Similar buoys are now available in which a horn is sounded by electrical means. Tests have also been made of buoys fitted with automatic radiobeacons.

JURISDICTION

The maintenance of aids to marine navigation is a function of the United States Coast Guard, having been placed under that organiza-

tion on July 1, 1939, and consists of the maintenance of lighthouses, lightships, radiobeacons, loran, fog signals, buoys, and daybeacons upon all navigable waters of the United States and its possessions; including Atlantic and Pacific coasts of continental United States, the Great Lakes, the Mississippi River and its tributaries, Puerto Rico, the approaches to the Panama Canal, the Hawaiian Islands, Alaska, and such other places where aids to navigation are required to serve the needs of the armed forces.

The chief administrative officer is the Commandant of the Coast Guard, with headquarters at Washington, D. C. Under his direction the functions of establishment, construction, maintenance, and operation of aids to navigation are carried on through administrative and engineering divisions in Washington. Because of the wide geographic distribution of aids to navigation on the sea coasts, the Great Lakes and navigable rivers of the United States, with an aggregate coast line of over 40,000 miles, the field work of the service is carried on by district organizations. There are 12 Coast Guard districts, carrying on lighthouse work, as well as other functions of the Coast Guard. Each district is under the supervision of a commander, assisted by a suitable engineering and administrative force, and equipped with the necessary supply and buoy depots, and with suitable vessels for the maintenance of the aids to navigation.

RELATED NAUTICAL PUBLICATIONS

NOTICE TO MARINERS (see page 26 for details)

Areas within Coast Guard district limits:

Issued by each Coast Guard district commander.

Free of charge from commander of Coast Guard district concerned.

North American-Caribbean weekly edition:

Prepared jointly by Coast Guard, Treasury Department, and Navy Hydrographic Office, Navy Department, and published by Navy Hydrographic Office.

Free of charge from Commandant (OAN), United States Coast Guard, Washington, D. C.

World weekly edition:

Published by Navy Hydrographic Office, Navy Department.

Free of charge from Navy Hydrographic Office, Washington, D. C.

Great Lakes weekly edition:

Prepared jointly by Coast Guard, Treasury Department, and Navy Department, and published by Navy branch hydrographic office.

Free of charge from Navy Branch Hydrographic Office, Cleveland, Ohio.

LIGHT LISTS (see page 23 for details)

Coasts of the United States, Territories, and possessions:

Published by Coast Guard, Treasury Department.
For sale by Superintendent of Documents, Government Printing Office, Washington, D. C., and sales agents.[1]

Foreign countries:

Published by Navy Hydrographic Office, Navy Department.
For sale by Navy Hydrographic Office, Washington, D. C., and sales agents.[1]

RADIOBEACONS AND LORAN (see page 11 for details)

Charts of radiobeacon system, Atlantic and Gulf coasts, Pacific coast, and Great Lakes:

Published by Coast Guard, Treasury Department.
Free to vessels equipped with radio direction finders from Commandant (OAN) United States Coast Guard, Washington, D. C.

Radio Navigational Aids (H. O. Pub. No. 205):

Published by Navy Hydrographic Office, Navy Department.
For sale by Navy Hydrographic Office, Washington, D. C., and sales agents.[1]

Loran charts and tables:

Published by Navy Hydrographic Office, Navy Department.
For sale by Navy Hydrographic Office, Washington, D. C.

NAUTICAL CHARTS

Coasts of the United States, Territories, possessions, and Philippine Islands:

Issued by Coast and Geodetic Survey, Commerce Department.
For sale by Coast and Geodetic Survey, Washington, D. C., and sales agents.[1]

Mississippi River from the Head of Passes to Cairo:

Issued and for sale by the Mississippi River Commission, Department of the Army, Vicksburg, Miss.

Illinois Waterway System:

Issued and for sale by the Corps of Engineers, Department of the Army, Chicago, Ill.

Ohio River:

Issued and for sale by the Corps of Engineers, Department of the Army, Cincinnati, Ohio.

Great Lakes, Lake Champlain, New York State Canals, and the St. Lawrence River, St. Regis to Cornwall, Canada:

Issued and for sale by the U. S. Lake Survey Office, Department of the Army, Detroit, Mich.

New York State Canal System:

Issued and for sale by the Superintendent of Public Works, State of New York, Albany, N. Y.

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[1] A list of sales agents for charts and publications is published quarterly in the Weekly Notice to Mariners.

Foreign countries:

Issued by Navy Hydrographic Office.
For sale by Navy Hydrographic Office, Navy Department, Washington, D. C., and sales agents.[1]

COAST PILOTS

Coasts of the United States, Territories, possessions, and Philippine Islands:

Published by Coast and Geodetic Survey, Commerce Department.
For sale by Coast and Geodetic Survey, Washington, D. C., and sales agents.[1]

Foreign countries:

Published by Navy Hydrographic Office, Navy Department.
For sale by Navy Hydrographic Office, Washington, D. C., and sales agents.[1]

TIDE TABLES

Atlantic Ocean, and Pacific and Indian Oceans:

Published by Coast and Geodetic Survey, Commerce Department.
For sale by Coast and Geodetic Survey, Washington, D. C., and sales agents.[1]

CURRENT TABLES

Atlantic Coast, North America, and Pacific Coast, North America, and Philippine Islands:

Published by Coast and Geodetic Survey, Commerce Department.
For sale by Coast and Geodetic Survey, Washington, D. C., and sales agents.[1]

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[1] A list of sales agents for charts and publications is published quarterly in the Weekly Notice to Mariners.

For sale by the Superintendent of Documents, U. S. Government Printing Office
Washington 25, D. C. - Price 25 cents